SPACE TELESCOPE SCIENCE INSTITUTE

FINAL TECHNICAL REPORT

Principal Investigator: Dr. Claus Leitherer
Project Title: *Ultraviolet Properties of Massive Stars in Starburst Galaxies*
Grant Number: NAG5-1639

We have measured the equivalent widths and central wavelengths of ten strong far-ultraviolet absorption-lines in IUE archival spectra of a sample of 50 starburst galaxies. We have also measured the far-UV continuum fluxes and colors for each galaxy. A comprehensive literature search was also undertaken to determine the absolute visual magnitude, mass, infrared luminosity, and average metal abundance for each galaxy. All these data have been entered into a master data-base, in a detailed statistical analysis of the sample, in an attempt to relate the massive star content of a galaxy to the other primary galaxian parameters which is underway.

We have also compared the IUE data to sophisticated synthetic galaxy spectra that we have constructed (Robert, Leitherer, and Heckman 1993). These spectra were constructed using state-of-the-art stellar evolution models for massive stars to make synthetic H-R Diagrams (given an assumed IMF and star-formation history). The H-R Diagrams were converted into synthetic spectra using High-Resolution IUE archival spectra of O stars and Low-Resolution IUE archival spectra of B stars. This allows us to predict the far-UV spectral properties of starbursts as a function of time, of assumed star-formation history, initial mass function, etc. We find that - contrary to some published results based on optical and IR nebular spectra - the initial mass function in starbursts extends to masses well in excess of 30 solar masses.

We have also analyzed far-UV HST FOC images of nine nearby starbursts in order (for the first time) to be able to delineate with 0.1 arcsec resolution the structure of the regions in which the unusually vigorous star-formation is occurring. In seven of our nine targets, the far-UV flux is similar to or exceeds the thermal dust emission measured by IRAS in the far-infrared, so that the UV images are not being heavily influenced by dust opacity in these cases. At our 0.1 arcsec resolution, the starbursts are resolved into multiple clumps and knots distributed over a region several hundred pc to a few kpc in size. This suggests that compact sites of star-formation may propagate from place to place within a larger central gas reservoir. The UV and optical properties of these clumps suggest that they may correspond to newly 'minted' globular clusters.

In conjunction with these efforts, we have recently completed a paper submitted to ApJ Supplements (Leitherer & Heckman 1994) that presents the results of an extensive grid of evolutionary synthesis models for populations of massive stars. For models spanning a range from 10% to twice solar metallicity, we have computed the time-dependence of the far-UV

properties (HI, HeI, and HeII ionizing fluxes, strength of the Lyman edge, far-UV colors), as well as the more traditional optical and near-IR colors. These models also predict the rate at which kinetic energy and mass is returned to the interstellar medium by massive stars (vital to our work on hot gas and galactic winds). Related work has been summarized by Leitherer (1993a,b) and Heckman (1994).

Related Publications

1. C. Robert, C. Leitherer, and T. Heckman 'Synthetic Ultraviolet Lines of SiIV, CIV, and HeII from a Population of Massive Stars in Starburst Galaxies', ApJ, 418, 749, 1993

2. C. Robert, C. Leitherer, and T. Heckman 'The Ultraviolet Signature of Massive Stars in Starburst Galaxies', in EVOLUTION OF GALAXIES & THEIR ENVIRONMENTS: CONTRIBUTED PAPERS (NASA Conference Series), p. 34, 1993

3. C. Robert, C. Leitherer, and T. Heckman 'The Ultraviolet Signature of Massive Stars in Starburst Galaxies', in THE FEEDBACK OF CHEMICAL EVOLUTION ON THE STELLAR CONTENT OF GALAXIES, ed. Alloin and Stasinska (Observatoire de Paris), 1993

4. C. Leitherer and T. Heckman, 'Synthetic Models of the UV, Optical, and Near- IR Properties of Starburst Galaxies', submitted to ApJSuppl.

5. G. De Marchi, A. Nota, C. Leitherer, R. Ragazzoni, and C. Barbieri, 'The Population of Massive Stars in R136 from FOC Ultraviolet Observations', ApJ, 419, 658, 1993

6. C. Leitherer, 'Output of Matter and Radiation by Massive Stars in Different Chemical Environments', in THE FEEDBACK OF CHEMICAL EVOLUTION ON THE STELLAR CONTENT OF GALAXIES, ed. Alloin and Stasinska (Observatoire de Paris), p. 241, 1993

7. C. Leitherer, 'Interaction of Massive Stars with the ISM', in STAR FORMATION, GALAXIES, AND THE INTERSTELLAR MEDIUM, ed. J. Franco, F. Ferrini, and G. Tenario-Tagle (Cambridge: Cambridge University Press), p. 211, 1993

8. C. Leitherer, 'Massive Stars in Starburst Galaxies and the Origin of Galactic Superwinds', in REVIEWS OF MODERN ASTRONOMY, ed. G. Klare (Hamburg: Astronomische Gesellschaft), in press

9. T. Heckman, 'Starbursts, Quasars, and the Evolution of Galaxies' in MASS-TRANSFER-INDUCED ACTIVITY IN GALAXIES, ed. I. Schlosman (Kluwer: Dordrecht), in press

FEDERAL CASH TRANSACTION REPORT

(See instructions on the back. If report is for more than one grant or assistance agreement, attach completed Standard Form 272-A.

Approved by Office of Management and Budget, No. 80-R0182

1. Federal sponsoring agency and organizational element of which this report is submitted.
NASA - GODDARD SPACE FLIGHT CENTER
ACCOUNTING BRANCH CODE 151-2
GREENBELT, MD 20721

2. RECIPIENT ORGANIZATION
Name
SPACE TELESCOPE SCIENCE INSTITUTE
Number and Street
3700 SAN MARTIN DRIVE
City, State & Zip Code:
BALTIMORE, MD 21218

3. FEDERAL EMPLOYER IDENTIFICATION NO. 86-0138043

4. Federal grant or other identification number. NAG5-1639

5. Recipient's account number identification number G001.66500

6. Letter of credit number 80005122

7. Last payment voucher number N/A

Give total number for this period

8. Payment Vouchers credited to your Account $37,599.66

9. Treasury checks received $0.00

10. PERIOD COVED BY THIS REPORT
FROM: 07/01/91 TO: 09/30/94

11. STATUS OF FEDERAL CASH (See specific instructions on the back)		
	a. Cash on hand beginning of reporing period.	0.00
	b. Letter of credit withdrawals - wire transfer	37,599.66
	c. Treasury check payments	0.00
	d. Total receipts (sum of lines b and c)	37,599.66
	e. Total cash available (Sum of lines a and d)	37,599.66
	f. Gross disbursements	37,599.66
	g. Federal share of program income	0.00
	h. Net disbursements (Line f minus line g)	37,599.66
	i. Adjustments of prior periods	0.00
	j. Cash on hand end of period	0.00

12. THE AMOUNT SHOW ON LINE 11J, ABOVE, REPRESENTS CASH REQUIREMENTS FOR THE ENSUING Days	13. OTHER INFORMATION	
	a. Interest income	0.00
	b. Advances to subgrantees or subcontractors	0.00

14. REMARKS (Attach additional sheets of plain paper, if more space is required)

FINAL 272 REPORT - NAG5-1639

15. Certification

I certify to the best of my knowledge and belief that this report is true in all respects and that all disbursements have been mande for the purpose and conditions of the grant or agreement.

AUTHORIZED CERTIFYING OFFICIAL

SIGNATURE Susan K Philbin

DATE REPORT SUBMITTED 8/16/94

TYPED OR PRINTED NAME AND TITLE
SUSAN K. PHILBIN ACCOUNTANT

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